National Aeronautics and Space Administration

Centaur Environmental Test—Space Power Chamber No. 1

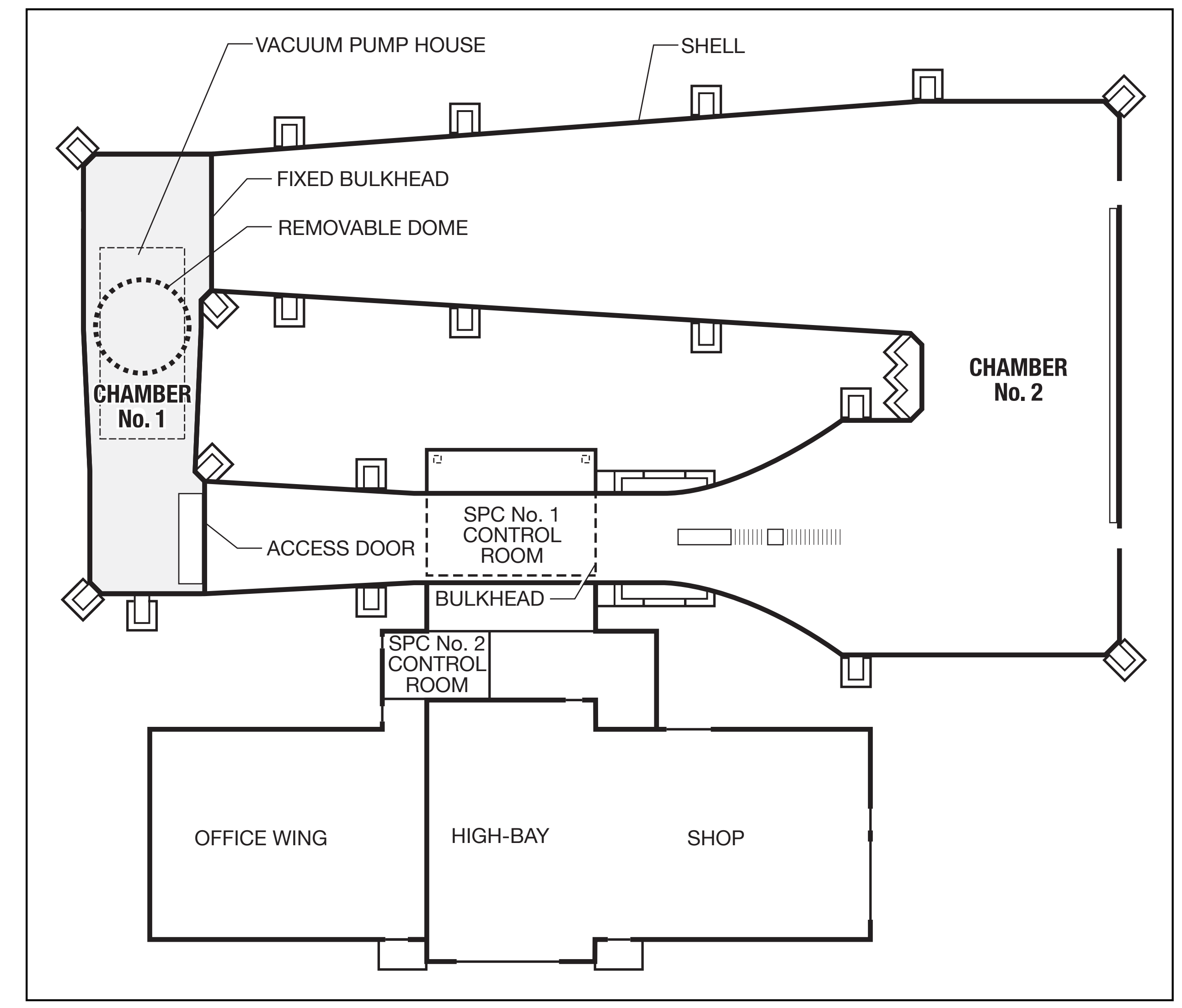
The Space Power Chambers (SPC) was among the first wave of large vacuum chambers built in the early 1960s to test space flight hardware in simulated space environments. The facility, built during 1961 and 1962 in the former Altitude Wind Tunnel (AWT), contained a vacuum chamber, SPC No. 1, in the eastern end and a high-altitude chamber, SPC No. 2, in the larger western end.

SPC No. 1 was 100 feet long, 31 feet in diameter at one end, and 27 feet in diameter at the other. An extension, removable dome, and other components were added in 1963 in order to accommodate the Centaur second-stage rocket. The Centaur program, acquired by NASA Lewis in October 1962, was intended to carry the Surveyor spacecrafts to the Moon ahead of the Apollo Program. As part of an intensive effort to improve the rocket, a full-scale Centaur was installed inside the SPC vacuum chamber for a series of qualification tests in a space environment.

The SPC No. 1 had a massive exhauster system in a pump house below the chamber that was tied into other exhauster systems at the Center. After the initial air was removed from the chamber, two piston pumps simultaneously removed 12.5 cubic feet of air per second during the roughing stage. A rotary positive displacement pump pulled additional air at 500 cubic feet per second. The final vacuum is pulled down by the ten 32-inch-diameter oil diffusion pumps, which could remove 17,650 cubic feet of air per second.

In addition to the vacuum, SPC No. 1 could simulate the low temperatures and solar radiation of space. A large copper cold wall with its interior coated with heat-absorbing black paint was created specifically for these tests and assembled around the Centaur. The 42-foot-high wall had vertical ribs filled with liquid nitrogen, which produced the low temperatures. Six panels of 500-watt tungsten-iodine lamps were arranged around the Centaur to simulate the effect of the Sun's heat on the rocket performance. Four of these arrays were on the upper end of the Centaur, and two were located near the RL–10 engines. Certain lamps could be turned on at different times to recreate the changing areas of the rocket exposed sunlight during a mission.

Centaur's autopilot, guidance, main propulsion, hydraulic, hydrogen peroxide supply, boost-pump attitude control, telemetry, tracking, range safety, and pneumatic systems were studied. These studies proved that the

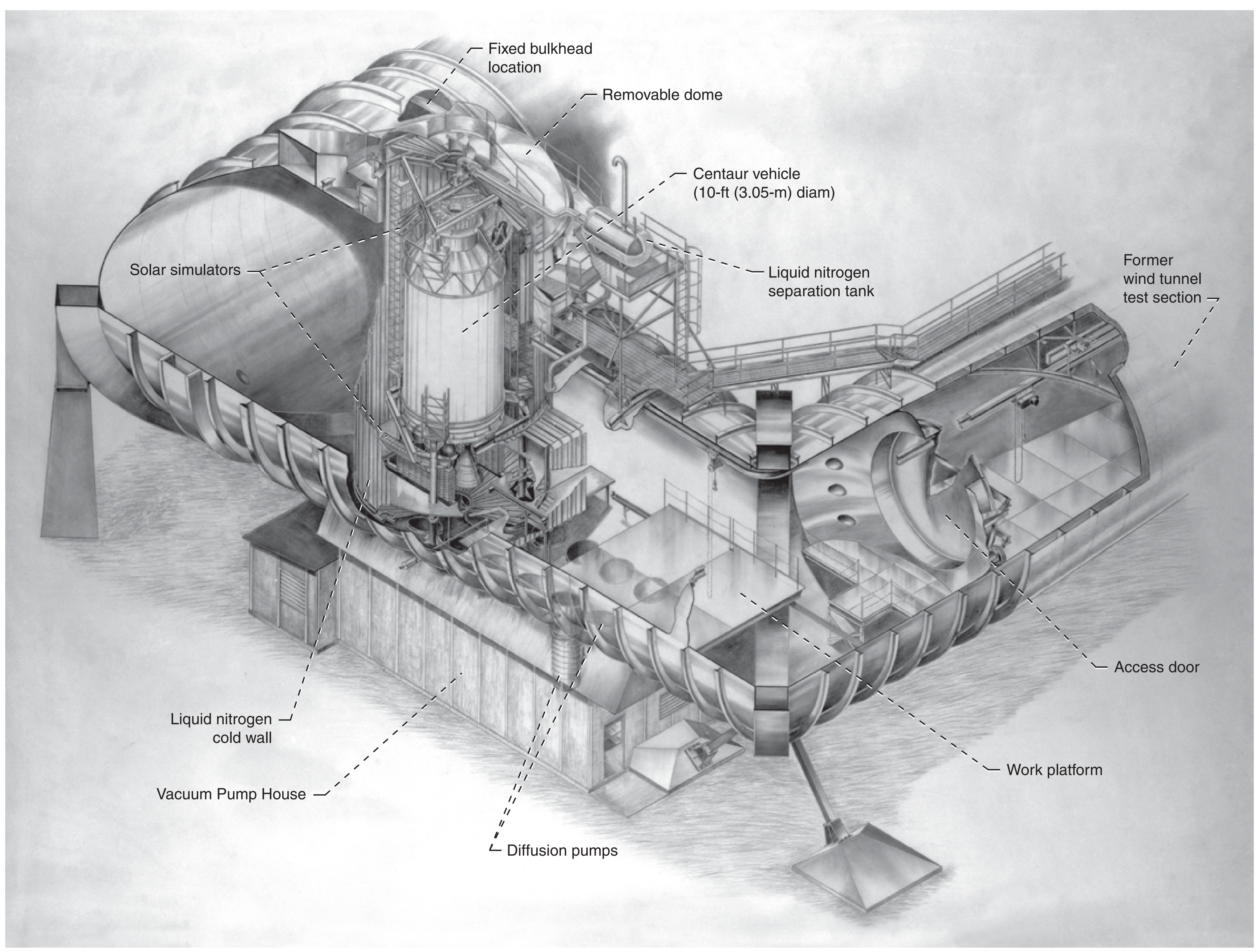


Centaur's electrical system could perform during a two-burn flight in a space environment. The few problems that were identified were rectified before the Surveyor flights. The researches also discovered the electronics did not create or absorb heat and that the pressurization of instrument packages was not needed and actually caused performance problems.

An open area in SPC No. 1 away from the cold wall was used to conduct separation tests of the Centaur/Surveyor nose fairing in 1964. A malfunction during the separation on the previous launch almost caused the mission to fail. The SPC investigations found that internal jet expansion separation devices could successfully jettison the fairing without damaging the payload. It was also determined that all separation tests must be conducted in a vacuum environment.

The larger SPC No. 2 chamber could simulate the conditions experienced in the upper levels of the atmosphere. Some of this chamber's investigations included Atlas/Centaur separation tests, shroud jettison studies for Centaur's Orbiting Astronomical Observatory (OAO) missions, and a number of liquid hydrogen propellant management studies. These included qualifying an Agena shroud converted for the Atlas/Centaur-6 mission, and redesigning the OAO shroud after a failure in 1968.

As launch vehicles and payloads became larger, the SPC became too small to continue shroud separation tests. Many of these studies were conducted in the massive Space Power Facility at Plum Brook, which began operating in 1969. SPC No. 1 had been dormant since the late 1960s and SPC No. 2 since 1975. The AWT/SPC facility has played a significant role in the progression of the nation's aerospace progress—from the World War II reciprocating engine to the first turbojet models to more advanced jets of the 1950s through Project Mercury, the Apollo Program, and ensuing Centaur interplanetary flights.



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